

# **Appendix C**

## **Calibration Certificates of Monitoring Equipment**



TISCH ENVIRONMENTAL, INC.  
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# ORIFICE TRANSFER STANDARD CERTIFICATION WORKSHEET TE-5025A

Date - Apr 07, 2014 Rootmeter S/N 0438320 Ta (K) - 294  
 Operator Tisch Orifice I.D. - 1612 Pa (mm) - 742.95

PLATE OR Run #	VOLUME START (m3)	VOLUME STOP (m3)	DIFF VOLUME (m3)	DIFF TIME (min)	METER DIFF Hg (mm)	ORFICE DIFF H2O (in.)
1	NA	NA	1.00	1.3940	3.2	2.00
2	NA	NA	1.00	0.9790	6.4	4.00
3	NA	NA	1.00	0.8800	7.8	5.00
4	NA	NA	1.00	0.8350	8.8	5.50
5	NA	NA	1.00	0.6910	12.7	8.00

## DATA TABULATION

Vstd	(x axis) Qstd	(y axis)	Va	(x axis) Qa	(y axis)
0.9866	0.7077	1.4077	0.9957	0.7142	0.8896
0.9823	1.0034	1.9908	0.9914	1.0127	1.2581
0.9804	1.1140	2.2258	0.9894	1.1243	1.4066
0.9791	1.1726	2.3345	0.9881	1.1834	1.4753
0.9739	1.4094	2.8155	0.9829	1.4224	1.7793
Qstd slope (m) = 2.00757			Qa slope (m) = 1.25710		
intercept (b) = -0.01628			intercept (b) = -0.01029		
coefficient (r) = 0.99989			coefficient (r) = 0.99989		
y axis = $\text{SQRT}[\text{H2O}(\text{Pa}/760)(298/\text{Ta})]$			y axis = $\text{SQRT}[\text{H2O}(\text{Ta}/\text{Pa})]$		

## CALCULATIONS

$$\begin{aligned} Vstd &= \text{Diff. Vol}[(\text{Pa}-\text{Diff. Hg})/760](298/\text{Ta}) \\ Qstd &= Vstd/\text{Time} \end{aligned}$$

$$\begin{aligned} Va &= \text{Diff Vol}[(\text{Pa}-\text{Diff Hg})/\text{Pa}] \\ Qa &= Va/\text{Time} \end{aligned}$$

For subsequent flow rate calculations:

$$\begin{aligned} Qstd &= 1/m\{[\text{SQRT}(\text{H2O}(\text{Pa}/760)(298/\text{Ta}))]-b\} \\ Qa &= 1/m\{[\text{SQRT} \text{H2O}(\text{Ta}/\text{Pa})]-b\} \end{aligned}$$

## TSP Sampler Calibration

### SITE

Location: Lian Tang 3                      Date: July 4, 2014  
 Sampler: TE-5170 MFC (Serial # : 2359)      Tech: Sam Wong

### CONDITIONS

Barometric Pressure (in Hg):	39.54	Corrected Pressure (mm Hg):	1004
Temperature (deg F):	90	Temperature (deg K):	305
Average Press. (in Hg):	39.54	Corrected Average (mm Hg):	1004
Average Temp. (deg F):	90	Average Temp. (deg K):	305

### CALIBRATION ORIFICE

Make: Tisch	Qstd Slope: 2.00757
Model: TE-5025A	Qstd Intercept: -0.01628
Serial#: 1612	Date Certified: April 7, 2014

### CALIBRATIONS

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION
1	12.00	1.968	58.0	65.88	
2	10.00	1.797	52.0	59.07	Slope = 33.1902
3	8.20	1.628	48.0	54.52	Intercept = 0.1472
4	5.20	1.298	38.0	43.16	Corr. coeff.= 0.9994
5	3.20	1.020	30.0	34.08	# of Observations: 5

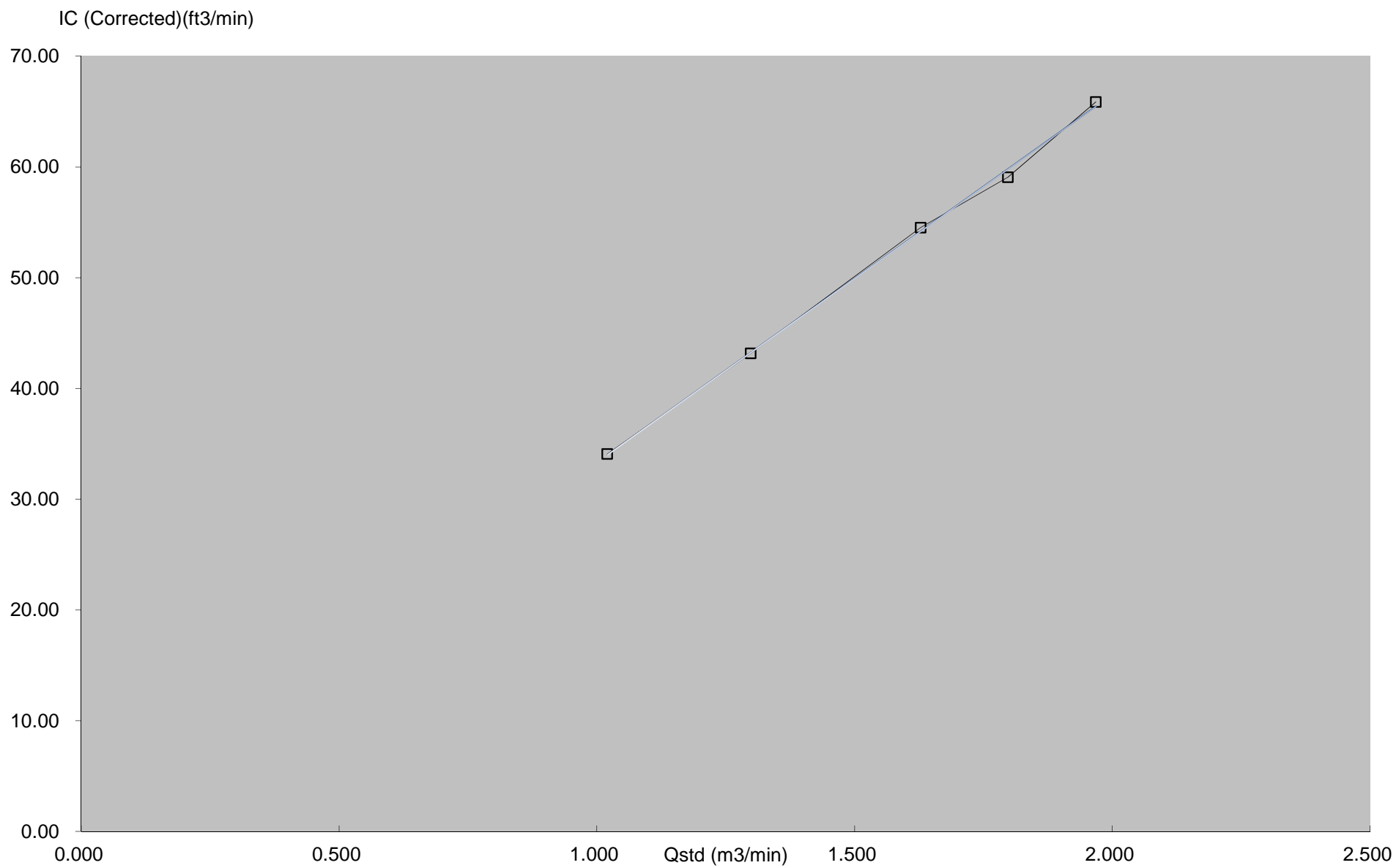
### Calculations

$Qstd = 1/m[\text{Sqrt}(H2O(Pa/Pstd)(Tstd/Ta))-b]$   
 $IC = I[\text{Sqrt}(Pa/Pstd)(Tstd/Ta)]$

Qstd = standard flow rate  
 IC = corrected chart response  
 I = actual chart response  
 m = calibrator Qstd slope  
 b = calibrator Qstd intercept  
 Ta = actual temperature during calibration (deg K)  
 Pa = actual pressure during calibration (mm Hg)  
 Tstd = 298 deg K  
 Pstd = 760 mm Hg

For subsequent calculation of sampler flow:  
 $1/m((I)[\text{Sqrt}(298/Tav)(Pav/760)]-b)$

m = sampler slope  
 b = sampler intercept  
 I = chart response  
 Tav = daily average temperature  
 Pav = daily average pressure







# Calibration Certificate

Certificate No. 37521

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**Customer :** Enovative Environmental Service Limited

**Address :** Room 3, 12/F., New City Centre, 2 Lei Yue Mun Road, Kwun Tong, Kowloon, H.K.

**Order No. :** Q32432

**Date of receipt :** 16-Oct-13

## Item Tested

**Description :** Sound Level Calibrator

**Manufacturer :** B&K

**Model :** Type 4231

**Serial No. :** 2685684

## Test Conditions

**Date of Test :** 31-Oct-13

**Supply Voltage :** --

**Ambient Temperature :** (23 ± 3)°C

**Relative Humidity :** (50 ± 25) %

## Test Specifications

Calibration check.

Ref. Document/Procedure : F21, Z02.

## Test Results

All results were within the IEC 942 Class 1 specification.

The results are shown in the attached page(s).


Main Test equipment used:

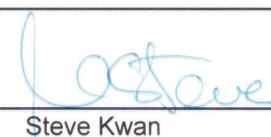
<u>Equipment No.</u>	<u>Description</u>	<u>Cert. No.</u>	<u>Traceable to</u>
S014	Spectrum Analyzer	35730	NIM-PRC & SCL-HKSAR
S205	Ref. Sound Level Calibrator	PHCO40002	SCL-HKSAR
S041	Universal Counter	34621	SCL-HKSAR
S206	Sound Level Meter	36203	SCL-HKSAR
S031	6½ dgt. Multimeter	30128	NIM-PRC

The values given in this Calibration Certificate only relate to the values measured at the time of the test and any uncertainties quoted will not include allowance for the equipment long term drift, variations with environmental changes, vibration and shock during transportation, overloading, mis-handling, or the capability of any other laboratory to repeat the measurement. Hong Kong Calibration Ltd. shall not be liable for any loss or damage resulting from the use of the equipment.

The test equipment used for calibration are traceable to International System of Units (SI).

The test results apply to the above Unit-Under-Test only

**Calibrated by :**   
Dorothy Cheuk

**Approved by :**   
Steve Kwan

This Certificate is issued by:

Hong Kong Calibration Ltd.

Unit 8B, 24/F., Well Fung Industrial Centre, No. 58-76, Ta Chuen Ping Street, Kwai Chung, NT, Hong Kong.

Tel: 2425 8801 Fax: 2425 8646

**Date:** 31-Oct-13



# Calibration Certificate

Certificate No. 37521

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Results :

## 1. Level Accuracy

UUT Nominal Value (dB)	Measured Value (dB)	IEC 942 Class 1 Spec.
94	94.08	± 0.3 dB
114	114.07	

Uncertainty : ± 0.1 dB

## 2. Frequency

UUT Nominal Value	Measured Value	IEC 942 Class 1 Spec.
1 kHz	1.002 kHz	± 2 %

Uncertainty : ± 3.6 x 10<sup>-6</sup>

## 3. Level Stability : 0.0 dB

IEC 942 Class 1 Spec. : ± 0.1 dB

Uncertainty : ± 0.01 dB

## 4. Total Harmonic Distortion : < 0.7 %

IEC 942 Class 1 Spec. : < 3 %

Uncertainty : ± 2.3 % of reading

Remark : 1. UUT : Unit-Under-Test

2. The uncertainty claimed is for a confidence probability of not less than 95%.

3. Atmospheric Pressure : 1014 hPa.

----- END -----



# Calibration Certificate

Certificate No. **36604**

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**Customer :** Enovative Environmental Service Limited

**Address :** Room 3, 12/F., New City Centre, 2 Lei Yue Mun Road, Kwun Tong, Kowloon, H.K.

**Order No. :** Q32395

**Date of receipt :** 4-Sep-13

## Item Tested

**Description :** Sound Level Meter (N12-RION-004)

**Manufacturer :** Rion

**Model :** NL-52

**Serial No. :** 00220553

## Test Conditions

**Date of Test :** 10-Sep-13

**Supply Voltage :** --

**Ambient Temperature :** (23 ± 3)°C

**Relative Humidity :** (50 ± 25) %

## Test Specifications

Calibration check.

Ref. Document/Procedure: Z01.

## Test Results

All results were within the IEC 61672 Type1 specification.

The results are shown in the attached page(s).

Main Test equipment used:

<u>Equipment No.</u>	<u>Description</u>	<u>Cert. No.</u>	<u>Traceable to</u>
S017	Multi-Function Generator	C127181	SCL-HKSAR
S205	Ref. Sound Level Calibrator	PHCO40002	SCL-HKSAR

The values given in this Calibration Certificate only relate to the values measured at the time of the test and any uncertainties quoted will not include allowance for the equipment long term drift, variations with environmental changes, vibration and shock during transportation, overloading, mis-handling, or the capability of any other laboratory to repeat the measurement. Hong Kong Calibration Ltd. shall not be liable for any loss or damage resulting from the use of the equipment.

The test equipment used for calibration are traceable to International System of Units (SI).

The test results apply to the above Unit-Under-Test only

**Calibrated by :**   
Dorothy Cheuk

**Approved by :**   
Steve Kwan

**Date:** 16-Sep-13

This Certificate is issued by:  
Hong Kong Calibration Ltd.  
Unit 8B, 24/F., Well Fung Industrial Centre, No. 58-76, Ta Chuen Ping Street, Kwai Chung, NT, Hong Kong.  
Tel: 2425 8801 Fax: 2425 8646

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# Calibration Certificate

Certificate No. 36604

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Results :

1. Self-generated noise: 16.4 dBA ( Mfr's Spec  $\leq 17$  dBA )

2. Acoustical signal test

UUT Setting			Applied Value (dB)	UUT Reading (dB)
Level Range (dB)	Weight	Response		
30 – 130	L <sub>A</sub>	Fast	94.0	94.0
		Slow		94.0
	L <sub>C</sub>	Fast		94.0
	L <sub>Z</sub>	Fast		94.0
	L <sub>A</sub>	Fast	114.0	114.0
		Slow		114.0
	L <sub>C</sub>	Fast		114.0
	L <sub>Z</sub>	Fast		114.0

IEC 61672 Type 1 Spec. :  $\pm 1.1$  dB

Uncertainty :  $\pm 0.1$  dB

3 Electrical signal tests of frequency weightings (A weighting)

Frequency	Attenuation (dB)	IEC 61672 Type 1 Spec.
31.5 Hz	-39.8	- 39.4 dB, $\pm 2$ dB
63 Hz	-26.4	- 26.2 dB, $\pm 1.5$ dB
125 Hz	-16.3	- 16.1 dB, $\pm 1.5$ dB
250 Hz	-8.7	- 8.6 dB, $\pm 1$ dB
500 Hz	-3.3	- 3.2 dB, $\pm 1.4$ dB
1 kHz	0.0 (Ref)	0 dB, $\pm 1.1$ dB
2 kHz	+1.2	+ 1.2 dB, $\pm 1.6$ dB
4 kHz	+0.9	+ 1.0 dB, $\pm 1.6$ dB
8 kHz	-1.1	- 1.1 dB, + 2.1 dB $\sim$ -3.1 dB
16 kHz	-8.0	- 6.6 dB, + 3.5 dB $\sim$ - 17.0 dB

Uncertainty :  $\pm 0.1$  dB





# Calibration Certificate

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## 4. Frequency & Time weightings at 1 kHz

### 4.1 Frequency Weighting (Fast)

UUT Setting	Applied Value (dB)	UUT Reading (dB)	Difference (dB)	IEC 61672 Type 1 Spec.
A	94.0	94.0 (Ref.)	--	± 0.4 dB
C	94.0	94.0	0.0	
Z	94.0	94.0	0.0	

### 4.2 Time Weighting (A-weighted)

UUT Setting	Applied Value (dB)	UUT Reading (dB)	Difference (dB)	IEC 61672 Type 1 Spec.
Fast	94.0	94.0 (Ref.)	--	± 0.3 dB
Slow	94.0	94.0	0.0	
Time-averaging	94.0	94.0	0.0	

Uncertainty : ± 0.1 dB

## 5. Level linearity on the reference level range

UUT Range	Applied Value (dB)	UUT Reading (dB)	Difference (dB)	IEC 61672 Type 1 Spec.
130 dB (Ref Level)	129.0	129.0	0.0	± 1.1 dB
	124.0	124.0	0.0	
	119.0	119.0	0.0	
	114.0	114.0	0.0	
	109.0	109.0	0.0	
	104.0	104.0	0.0	
	99.0	99.0	0.0	
	94.0	94.0 (Ref)	--	
	89.0	89.0	0.0	
	84.0	84.0	0.0	
	79.0	79.0	0.0	
	74.0	74.0	0.0	
	69.0	69.0	0.0	
	64.0	64.0	0.0	
	59.0	59.0	0.0	
	54.0	54.0	0.0	
	49.0	49.0	0.0	
	44.0	44.0	0.0	

Uncertainty : ± 0.1 dB



# Calibration Certificate

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## 6. Toneburst response (4kHz)

UUT Setting	Tone Burst Duration(ms)	UUT Reading(dB)	Difference (dB)	IEC 61672 Type 1 Spec.
Fast	Steady	127.0(Ref)	--	--
	200	126.0	-1.0	-1.0 ± 0.8dB
	2	108.9	-18.1	-18.0, +1.3 dB ~ -1.8 dB
	0.25	99.9	-27.1	-27.0, +1.3 dB ~ -3.3 dB
Slow	Steady	127.0(Ref)	--	--
	200	120.2	-6.8	-7.4 ± 0.8dB
	2	100.6	-26.4	-27.0, +1.3 dB ~ -3.3 dB
Time averaging	Steady	127.0(Ref)	--	--
	200	120.1	-6.9	-7.0±0.8dB
	2	99.5	-27.5	-27.0, +1.3 dB ~ -1.8 dB
	0.25	91.7	-35.3	-36.0, +1.3 dB ~ -3.3 dB

Uncertainty : ± 0.1 dB

## 7. Overload indication (130 dB range, A-weighted, Time-average, 4kHz)

UUT Reading at overload (dB)		Difference (dB)	IEC 61672 Type 1 Spec.
+ ve one half cycle	- ve one half cycle		
138.4	138.2	0.2	< 1.8 dB

The overload indicator latched on until reset

Uncertainty : ± 0.1 dB

Remarks : 1. UUT : Unit-Under-Test

2. The uncertainty claimed is for a confidence probability of not less than 95%.

3. Atmospheric Pressure : 996 hPa.

4. Preamplifier model : NH-25 , S/N : 10553

5. Firmware Version: 1.2

6. Power Supply Check: OK

7. The UUT was adjusted with the laboratory's sound calibrator at the reference sound pressure level before the calibration.

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